LEVEL II

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Research Note 79-9

A TECHNIQUE FOR PRODUCING REALISTIC PHOTOGRAPHS OF TACTICAL SCENES EMPLOYING MODEL VEHICLES

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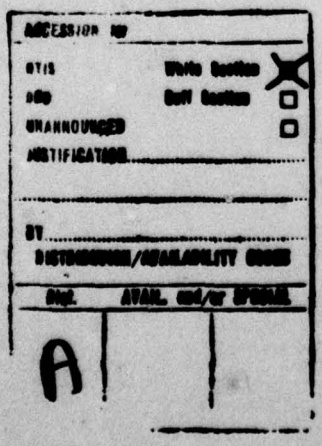

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FOREWORD

The Fort Hood Field Unit of the Army Research Institute for the Behavioral and Social Sciences (ARI) provides support to Headquarters, TCATA (TRADOC Combined Arms Test Activity). This support is provided by assessing human performance aspects in field evaluations of man/weapons systems.

A war using modern weapons systems is likely to be both intense and short. US man/weapons systems must be effective enough, immediately, to offset greater numbers of enemy weapons systems. Cost-effective procurement of improved or new combat systems requires testing that includes evaluation of the systems in operational settings similar to those in which the systems are intended to be used, with troops representative of those who would be using the systems in combat. The doctrine, tactics, and training packages associated with the systems being evaluated must themselves also be tested and refined as necessary.

This report describes a montage technique for producing realistic imagery for training purposes. The technique involves the combination of photographs of model tanks with photographs of real terrain, permitting training authorities to display a variety of vehicles in realistic tactical deployments.

ARI research in this area is conducted as an in-house effort, and as joint efforts with organizations possessing unique capabilities for human factors research. The research described in this report was done by personnel of the Human Resources Research Organization (HumRRO), under contract MDA907-78-C-2017, monitored by personnel from the ARI Fort Hood Field Unit. This research is responsive to the special requirements of TCATA and the objectives of RDTE Project 2Q763743A775, "Human Performance in Field Assessment," FY 1978 Work Program.

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Technical Director

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A TECHNIQUE FOR PRODUCING REALISTIC PHOTOGRAPHS OF TACTICAL SCENES EMPLOYING MODEL VEHICLES

BRIEF

Requirement:

The effort described in this report is that referred to in paragraph 4.b.(1) of the Statement of Work, dated 14 March 1978 under the title, "Development of Imagery for Target Handoff and Target Identification Training." Imagery suitable for training for other than US armored vehicles is difficult to obtain. Most available photographs were taken at close range, and provide detail which cannot be seen at tactical ranges. A technique for displaying both NATO and Warsaw Pact vehicles in realistic deployments at simulated tactical ranges was needed for realistic training. An effort was mounted to develop a procedure for producing imagery which was within the capability of Army audiovisual support centers.

Procedure:

A montage technique was developed by which photographs of model tanks can be combined with photographs of real terrain to produce realistic imagery. To accomplish this, a color slide of a real terrain background is projected onto a white screen. Small black-and-white photographs of the model vehicles are then positioned on the projection in realistic deployments. The montage is then photographed to produce the final training imagery.

Utilization of Findings:

The utilization of this procedure will permit training developers to obtain imagery which is tailored to their particular needs. That is, they can choose the type(s) of terrain desired, show various kinds of deployments, and can display both Warsaw Pact and NATO vehicles in the same scene.

CONTENTS

A TECHNIQUE FOR PRODUCING REALISTIC PHOTOGRAPHS OF TACTICAL SCENES EMPLOYING MODEL VEHICLES

The development of imagery for training in areas such as armored vehicle recognition is often frustrated by the difficulty of finding a variety of good photographs of realistically deployed vehicles in a tactical environment. This is especially true for the Warsaw Pact vehicles. This report will describe a montage technique by which photographs of tank models can be combined with photos of real terrain backgrounds to produce realistic imagery (see Figure 1). The process is quite simple: a color slide of a real terrain background is projected onto a large sheet of white paper used as a screen, and small black-and-white photographs of model tanks are then positioned on the projection so that they look natural. The combination of the two types of imagery is then photographed to produce the montage. The resulting photographs can appear quite realistic, even more so than terrain model or sandtable imagery, because of the authenticity of the terrain backgrounds.

Models

Many hobby shops carry several brands of plastic model tanks and other military vehicles. These models, usually produced in Europe, are made to 1/87 (HO scale) to 1/100 and usually require only minor assembly. Some models, not available in these smaller scales, are produced in 1/35 scale. The models should be compared to pictures of actual equipment to be sure that they are similar. For example, the model of the US M60A1 battle tank does not come with the searchlight that is usually mounted over the base of the gun. This feature could easily be added to the model. Commerically-produced models of some of the new vehicles such as the Soviet T-72 tank may not be available. In this case, it might be possible to obtain a model from a training aids center.

Since the models typically have an unrealistic glossy finish, they should be spray painted with one of the flat military colors (e.g., olive drab) that are available. If camouflage painting is required, small bottles of camouflage colors may also be found at the hobby shop. Care should be taken to avoid obscuring detail with a heavy coat of paint. Information concerning camouflaging may be found in FM 5-20[1] and TC 5-200.[2]

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[1] US Department of the Army, Washington, D.C. Field Manual 5-20, *Camouflage*, 20 May 1968.

[2] US Department of the Army. Training Circular 5-200, *Camouflage Pattern Painting*, US Army Engineer School, Deputy Commandant for Combat and Training Developments, Fort Belvoir, Virginia, August 1975.

Photographing the Models

When the models have been prepared, they should be photographed against a white background under a diffuse light (see Figure 2). The model shots are taken using a black-and-white negative film such as Kodak Plus-X. A closeup lens or some other closeup attachment (supplementary lens, extension tubes, or bellows) will be required to photograph the small models. A small lens opening (f16 - f22) should be used to be sure that all of the vehicle is in focus.

In order for the final montage photographs to look real, it is important that the angle between the camera and the model is the same as that between the camera and the terrain background. The photographs shown here were meant to represent a view as seen from a low flying helicopter. For this reason, the camera was tilted down toward the model at an angle of 10° to 15° from the horizontal to match the angle at which the terrain was photographed.

When the model negatives have been obtained, small black-and-white prints must be made. The size of the prints will depend upon several factors; the particular terrain background to be used, the type of vehicle to be shown, and the position of the vehicle on the background. For example, the personnel carrier shown in the lower left corner of Figure 1 is a smaller vehicle than the tanks shown in the center of the picture. The tanks were printed smaller because they are to appear farther away. The best procedure to follow is to pick the terrain slide that is to be used and then decide where and what vehicles are to be shown. Then, the required sizes may be decided upon and prints made. Useful sizes will run from 1 inch to about 2 1/2 inches in length (see Figure 3).

In some cases, photographs of actual equipment could be used for the montage pictures if the vehicle was shown against a light background, or, the photographer could carefully bleach or cut all of the surrounding detail away, leaving only the image of the vehicle. This could be done for those vehicles for which no model is available.

Terrain Slides

One of the constraints of the montage technique is that the background slides have to have open areas of light color such as grassy areas or areas of bare earth in which the model photos can be placed. If the model photos are located in an area that contains bushes or other detail, then that detail will be superimposed on the vehicle, resulting in an unrealistic scene. Vehicles can be shown in defilade. However, cutting the print to exactly match the contours of the obscuring terrain feature can be extremely difficult.

The background slide used to produce the slide shown in Figure 1 was taken at Fort Hood, Texas, in the late summer. The grassy areas were of a light yellow color that allowed the tanks to be superimposed over them. The terrain slides obtained at Fort Hood were taken through the open door of a helicopter at altitudes of 50-200 feet. A fast shutter speed was used to avoid blurring due to the motion and vibration of the aircraft. Some terrain slides were also taken from hilltops. As with the model shots, the camera was pointed down at an angle of 10° to 15°. Shadows were minimized by taking the terrain shots at midday and pointing the camera in a northerly direction.

Montage Slides

Figure 4 shows the arrangement employed for taking the montage slides. A large blackboard covered with a piece of plywood was used as a copy stand. Large sheets of white paper from a sketch pad were tacked to the plywood to serve as a projection screen. A Carousel slide projector was placed about 8 feet from the copy stand to project the terrain slides onto the white paper. The projector used a 4-6 inch zoom lens and a DEK 500 watt lamp. A 35mm camera fitted with a 70-210mm zoom lens was positioned on a sturdy tripod just behind and above the projector. The camera's zoom lens was used at a focal length of about 150mm. (A fixed focal length lens of 150mm could also be used, providing that it focuses down to about 8 feet. Using a shorter length lens on the projector will allow a shorter lens to be used on the camera.)

A terrain slide is projected on the screen and the black-and-white photographs of the tank models are attached to the paper with double-sided tape, as shown in Figure 5. Any glare from the edges of the photographs can usually be eliminated by tilting the copy stand downward slightly. The "whiteness" of the photo print paper should match that of the paper used as a screen so that the edges of the prints blend into the scene. Polycontrast single weight print paper with a glossy surface seems to give good results.

The black-and-white images pick up color from the background slide to become a part of the scene. The realism of the vehicles is increased by using a felt tip pen to add "shadows" around the bottoms of the vehicles, as shown in Figure 6. The shadows should match those of the surrounding bushes and landscape features. If the shadows are not added, the vehicles seem to "float" in the final result.

Several types of film have been used to make the montage slides and photographs. Both tungsten and daylight type Ektachrome slide film have been used and it has been found that while the daylight film gives a rather yellow slide, it seems to be more acceptable than the bluish slide obtained from the tungsten film. A more natural slide can be obtained with the daylight film by using a No. 80A blue filter.

Light meter readings (based on film speed) of the projected terrain slides to not give good exposures due to the nature of the projected light; therefore, it is better to shoot a test roll to determine the best exposure to use. When the proper exposure has been found, the light meter may be used with a new exposure index value. It will be found that the exposures will vary several stops, depending upon the brightness of the terrain slides. Table 1 gives several combinations of film and exposures that may be used. (ASA ratings are given instead of exposure indexes.)

Multiple copies of the montage slides are best obtained by taking multiple originals or by copying the originals using a slide duplicating film. A slide duplicating film, such as Kodak 5071, will insure that slide copes have no more contrast than the originals.

The production of montage imagery requires rather extensive preparation to gather the models, shoot terrain shots, and produce suitable montage results. However, once the preparations have been made, the terrrain slides and the model shots may be used over and over again at little additional expense.

The technique described has been employed successfully in developing training programs for both vehicle recognition and air-to-air target handoff.[3] It has the advantage of allowing training developers to tailor the imagery to their particular needs. For example, they can choose the type(s) of terrain they desire, show various kinds of deployments, and display both Warsaw Pact and NATO vehicles in the same scene. Except for the photographer's time, it is a relatively inexpensive procedure and requires no equipment that is not normally available in audiovisual support centers.

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[3] W. H. Ton, P. W. Hemingway, and G. D. Chastain. *Further study of target handoff techniques*, HumRRO Final Report FR-WD-TX-78-5 (ARI Technical Report, in process).

Figure 1 ↑

Figure 2 ↓

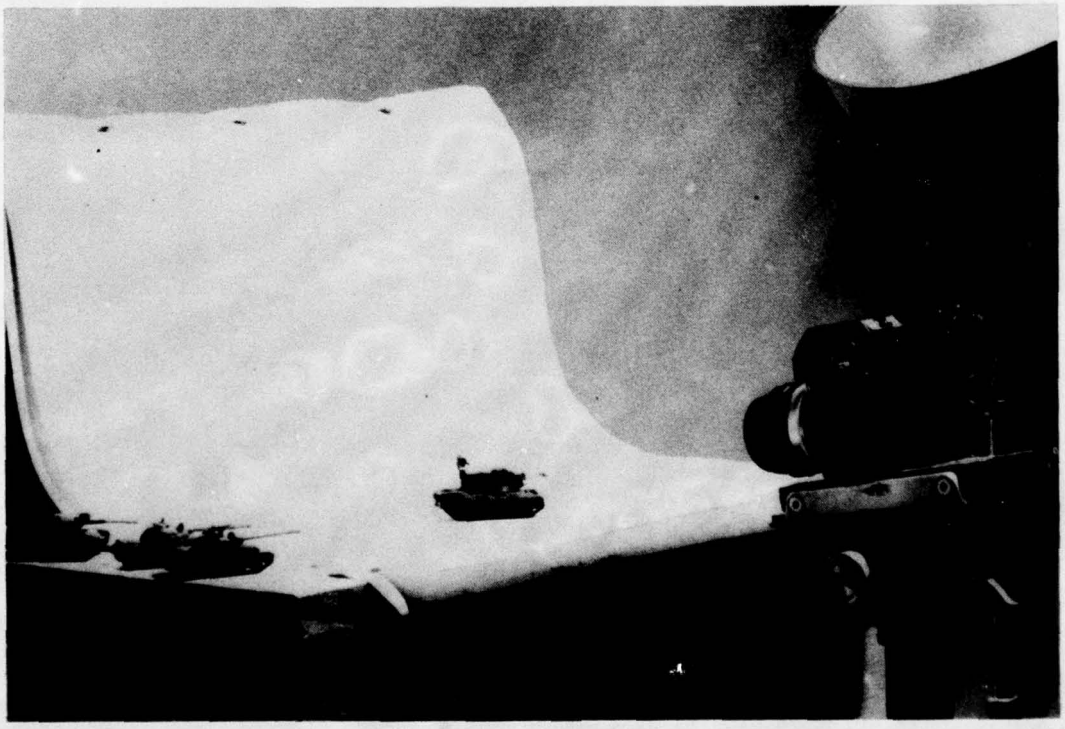

Figure 3 ↑

Figure 4 ↓

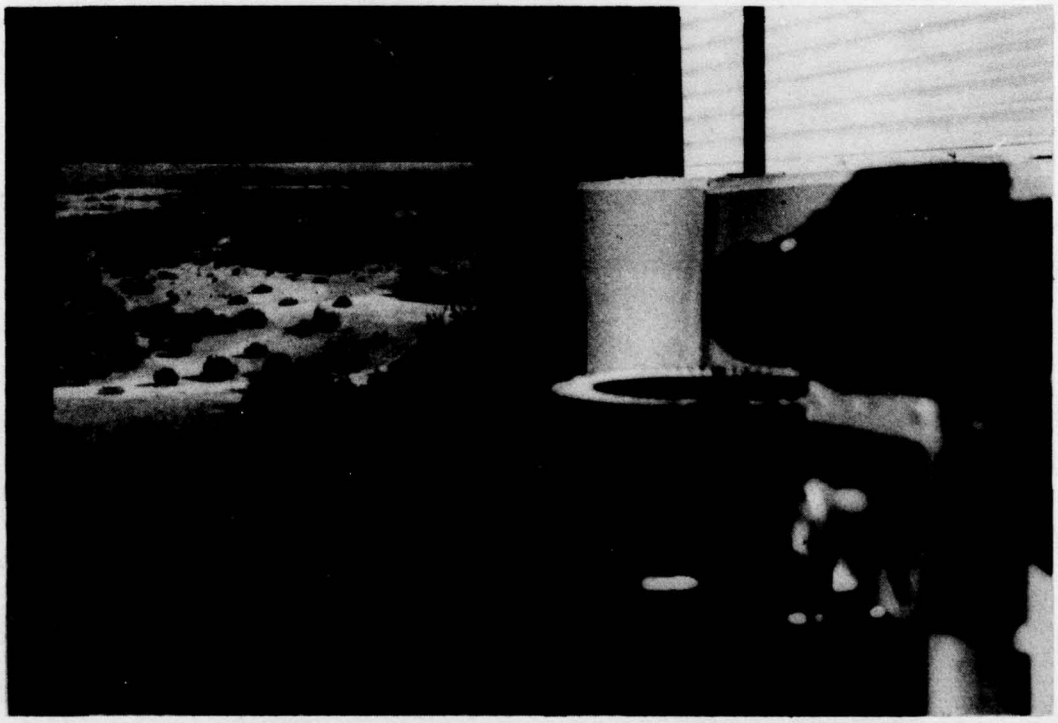

Figure 5 ↑

Figure 6 ↓

Table 1.

Film	ASA	f Stop	Exposure Time
Ektachrome 64 ER, EPR Slide Film	64	5.6	1/4 - 1/2 sec. 1/2 - 1 sec. with No. 80A filter
Ektachrome 200 ED, EPD Slide Film	200	5.6	1/15 - 1/8 sec.
Plus-X BW Negative Film	125	5.6	1/4 - 1/2 sec.

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Ton, W. H., Hemingway, P. W., and Chastain, G. D. *Further study of target handoff techniques*, HumRRO Final Report FR-WD-TX-78-5, May 1978. (ARI Technical Report, in process.)

US Department of the Army, Washington, D.C. Field Manual 5-20, *Camouflage*, 20 May 1968.

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